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PATENT *FS*

THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:
Robert Laws et al.

Serial No.: 10/070,228

Filed: 10/3/2002

For: A Method Of Seismic Surveying, A Marine
Vibrator Arrangement, And A Method Of
Calculating The Depths Of Seismic Sources

Group Art Unit: 3662

Examiner: Ian J. Lobo

Atty. Dkt. No.: 2088.000400/JAP

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APPEAL BRIEF

Customer No.: 23720

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Sir:

Applicant hereby submits an Appeal Brief to the Board of Patent Appeals and Interferences in response to the final Office Action dated June 17, 2005. The fee for filing this Appeal Brief is \$500, and is attached hereto.

If the check is inadvertently omitted, or should any additional fees under 37 C.F.R. §§ 1.16 to 1.21 be required for any reason relating to the enclosed material, or should an overpayment be included herein, the Director is authorized to deduct or credit said fees from or to Williams, Morgan & Amerson, P.C. Deposit Account No. 50-0786/2088.000400/JAP.

REAL PARTY IN INTEREST

The present application is owned by WesternGeco, LLC.

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RELATED APPEALS AND INTERFERENCES

Applicants are not aware of any related appeals and/or interferences that might affect the outcome of this proceeding.

STATUS OF THE CLAIMS

Per the “final” Office Action, claims 1-30 are pending in the case, claims 11-18 having been withdrawn from consideration. In the Office Action, the Office rejected:

- claims 1-8 as obvious under 35 U.S.C. § 103 (a) by either International Patent Application WO 9706452 (“Bouyoucus I”), United States Letters Patent 5,469,404 (“Barber *et al.*.”) or United States Letters Patent 5,535,176 (“Yang”), in view of U.S. Letters Patent 5,724,306 (“Barr”) and U.S. Letters Patent 4,918,668 (“Sallas”);
- claims 1 and 6-8 as obvious under 35 U.S.C. § 103 (a) by either United States Letters Patent 4,493,061 (“Ray”) or United States Letters Patent 4,136,754 (“Manin”) in combination with Barr and Sallas;
- claims 1 and 6 as obvious under 35 U.S.C. § 103 (a) by United States Letters Patent 4,727,956 (“Huizer”) in light of Barr and Sallas;
- claims 1-10 as obvious under 35 U.S.C. § 103 (a) by UK patent application GB 2,148,503 (“Lugg”) with Barr and Sallas;
- claims 1-8, 19-29 as obvious under 35 U.S.C. § 103 (a) by United States Letters Patent 4,721,180 (“Haugland *et al.*.”) in light of Barr and Sallas; and

Claim 30 was objected to as allowable but for its dependence from a rejected base claim. Applicants appeal each of the rejections.

STATUS OF AMENDMENTS

There were no amendments filed subsequent to the “final” Office Action.

SUMMARY OF CLAIMED SUBJECT MATTER

In marine seismic surveying, a seismic source emits seismic energy in a generally downwards direction into the water. The seismic energy is reflected by the sea bed and by the geological structures beneath the sea bed. The reflection is received by an array of seismic receivers, such as hydrophones. Analysis of the received energy—*i.e.*, the reflection—can provide information about the geological structures beneath the seabed.

One type of seismic source for marine surveys is a “marine vibrator.” Typically, an array of vibrators distributed in a horizontal direction is used. The vibrators in the array are suspended at a fixed common depth beneath suitable floats. The vibrators are distributed perpendicularly to the direction of tow and are operated periodically, for example every 20 seconds or so, to produce their respective 8 to 15 second swept frequency outputs.

One problem associated with conventional marine seismic surveying using a marine vibrator is that the downwardly directed seismic wave is actually the sum of two signals. In addition to the direct signal from the marine vibrator, there is also a reflected signal, or “ghost” signal, from the sea surface. Essentially, the initial reflection of the direct signal is reflected once again by the water’s surface and heads back down to the sea bed. This has several undesirable effects on the collected data.

The present invention addresses this problem. In general, during the course of a seismic sweep, seismic energy is emitted at two or more different depths. Energy emitted at one depth will have a different ghost filter from the energy emitted at another depth and the amplitude of the energy spectrum at low frequencies can be increased. References below are to the PCT application as published. More particularly, with respect to claim 1, a method of seismic surveying, the invention comprises emitting seismic energy at two or more different depths during a sweep. (p. 8, lines 16-31; p. 10, line 25 – p. 11, line 11) With respect to claim 6, a seismic surveying arrangement, the method comprises:

- a vessel (4);
- a source of seismic energy (1, Figure 6 – Figure 7; p. 10, line 25 – p. 11, line 11); and
- means (6,7) for suspending the source of seismic energy from the vessel;

wherein the source of seismic energy is an array of two or more marine vibrators, the array being suspended in use such that a first vibrator is disposed at a first depth and a second vibrator is disposed at a second depth greater than the first depth (p. 10, line 25 – p. 11, line 11).

With respect to claim 25, a seismic surveying arrangement, the invention comprises:

- a vessel (4);
- a marine vibrator (1, Figure 6 – Figure 7; p. 8, lines 16-31);
- means (6,7) for suspending the marine vibrator from the vessel;
- a first control means (p. 9, line 26 – p. 10, line 11) for causing the marine vibrator to emit seismic energy; and
- a second control means (p. 9, line 26 – p. 10, line 11) for varying the depth of the marine vibrator as it emits the seismic energy.

GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

- A. Whether claims 1-8 are obvious under 35 U.S.C. § 103 (a) by International Patent Application WO 9706452 (“Bouyoucus I”)¹ in view of U.S. Letters Patent 5,724,306 (“Barr”) and U.S. Letters Patent 4,918,668 (“Sallas”).
- B. Whether claims 1-8 are obvious under 35 U.S.C. § 103 (a) by United States Letters Patent 5,469,404 (“Barber *et al.*”) in view of Barr and Sallas.
- C. Whether claims 1-8 are obvious under 35 U.S.C. § 103 (a) by United States Letters Patent 5,535,176 (“Yang”) in view of Barr and Sallas.
- D. Whether claims 1 and 6-8 are obvious under 35 U.S.C. § 103 (a) by United States Letters Patent 4,493,061 (“Ray”) in combination with Barr and Sallas.
- E. Whether claims 1 and 6-8 are obvious under 35 U.S.C. § 103 (a) by United States Letters Patent 4,136,754 (“Manin”) in combination with Barr and Sallas.
- F. Whether claims 1 and 6 are obvious under 35 U.S.C. § 103 (a) by United States Letters Patent 4,727,956 (“Huizer”) in light of Barr and Sallas.

¹ This reference is referred to as “Bouyoucus I” because earlier in the prosecution the Office also cited U.S. Letters Patent 5,995,452 (“Bouyoucus II”), which is the U.S. Nationalization of Bouyoucus I under the Patent Cooperation Treaty. The Office subsequently apparently withdrew rejections predicated on Bouyoucus II, relying solely on Bouyoucus I.

G. Whether claims 1-10 are obvious under 35 U.S.C. § 103 (a) by UK patent application GB 2,148,503 (“Lugg”) with Barr and Sallas.

H. Whether claims 1-8, 19-29 are obvious under 35 U.S.C. § 103 (a) by United States Letters Patent 4,721,180 (“Haugland *et al.*”) in light of Barr and Sallas.

ARGUMENT

A. CLAIMS 1-8 ARE ALLOWABLE OVER BOUYOUCUS I IN VIEW OF BARR AND SALLAS

The “final” Office Action rejected claims 1-8 as obvious under 35 U.S.C. § 103 (a) over International Patent Application WO 9706452 (“Bouyoucous I”) in view of U.S. Letters Patent 5,724,306 (“Barr”) and U.S. Letters Patent 4,918,668 (“Sallas”). The Office states that “...the difference between the instant claims and [Bouyoucous I *et al.*] lies in the type of marine seismic sources used.” Applicants do not accept this characterization of the cited art in the sense that it implies that this is the *only* difference. There are other differences. However, the Office has admitted this difference. Applicants respectfully submit that the Office has improperly discounted the significance of that difference and that, when properly considered, this difference eviscerates the rejection.

1. THE DIFFERENCE BETWEEN IMPULSE SOURCES AND SWEEP SOURCES IS SIGNIFICANT

Bouyoucous I is all about air guns, which are impulse sources—and which are fundamentally different from sweep sources such as those in the present invention. Bouyoucous I spends a great deal of time talking about the principle of operation for airguns. It explains that the frequency spectrum of signal generate by a single airgun “...is inadequate to yield the resolution required for seismic exploration.” (p. 2, lines 12-13) The art therefore employs airguns in arrays to achieve a suitable spectrum. (p. 2, lines 13-15) Bouyoucous I teaches employing a vertically aligned array to produce a desirable affect on characteristics of the spectrum. (p. 3, line 7-p. 4, line 5) That is, Bouyoucous I is teaching a technique used shape the seismic signal generated by an array of impulse sources.

Almost as important is what Bouyoucus I does *not* teach. As noted above in the summary, the present invention addresses problematical notch frequencies arising from ghost reflections of the original seismic signal. Nowhere does Bouyoucus I address notch frequencies or even surface reflections. The Office has not alleged such and Applicants' review has produced none. Furthermore, Bouyoucus I does not teach *anything* having to do with sweep sources. A principle reason for this is the fundamental differences between impulse sources and sweep sources.

The independent claim, claim 1, recites at least one "marine vibrator", which is a sweep source. One distinction between sweep sources and impulse sources is that, unlike impulse sources, sweep sources produce a signal whose spectrum yields sufficient resolution. Thus, the whole point of the invention in Bouyoucus I is moot with respect to Applicants' invention. Furthermore, approaches mitigating the effects of notch frequencies in impulse sources are generally inapplicable to sweep sources. (p. 4 of the specification at filed, lines 18-25). Thus, the differences between the cited art such as Bouyoucus I employing impulse sources and Applicant's invention employing sweep sources is, indeed, material.

2. THE DIFFERENCE IN SOURCES MEANS THAT BOUYOUCUS I IS NOT PROPERLY COMBINABLE WITH BARR AND SALLAS

Thus, the question arises—why would one skilled in the art attempting to mitigate notch frequencies arising from ghost reflections of a sweep signal look to a reference teaching a technique for shaping an impulse signal? This question is particularly pertinent when one realizes that notch frequency mitigation techniques for ghost reflections of impulse signals are not generally applicable to sweep signals. The answer is that, one would not unless they had the benefit of Applicants' disclosure.

Procedurally, where multiple references are cited, the Office bears the burden of establishing that the references are combinable. *In re Oetiker*, 24 U.S.P.Q.2d (BNA) 1443, 1446 (Fed. Cir. 1992); *In re Fine*, 5 U.S.P.Q.2d (BNA) 1596, 1598 (Fed. Cir. 1988). More particularly:

[A] proper analysis under § 103 requires, *inter alia*, consideration of two factors: (1) whether the prior art would have suggested to those of ordinary skill in the art that they should make the claimed composition or device, or carry out the claimed process; and (2) whether the prior art would also have revealed that

in so making or carrying out, those of ordinary skill would have a reasonable expectation of success. Both the suggestion and the reasonable expectation of success must be founded in the prior art, not in the applicant's disclosure.

In re Vaeck, 20 USPQ2d 1438 (Fed. Cir. 1991) (citations omitted. There are at least three major flaws, each fatal, under *Vaeck* in the Office's *prima facie* case:

- the reasoning rests on the irrelevant considerations of ubiquity and environmental favoritism of sweep-type sources;
- there is no suggestion for the combination *in the prior art*; and
- the Office has failed to demonstrate a "reasonable expectation of success" arising from the combination.

Applicants further develop each of these positions below.

The Office admits that Bouyoucus I teaches nothing about sweep sources. The Office attempts to remedy the deficiencies of Bouyoucus I by combining it with either Barr or Sallas. The Office Action supports the combination as follows:

Therefore, in view of the well known use of air guns and marine vibrators as seismic energy sources in the marine environment, and the preference for marine vibrators over air guns, especially to environmentalists, it would be obvious to one of ordinary skill in the art to substitute a marine vibrator for the air guns of Bouyoucus I [sic], Barber [sic] et al, Yang, Lugg, Manin, Ray, Huizer or Haugland et al.

"Final" Office Action, Detailed Action, p. 4, ¶ 6. However, the *prima facie* case is defective because the references have not been properly combined.

The first error is that the Office's reasoning rests on an irrelevant consideration—ubiquity and "environmental favoritism" are not relevant to the problem facing the inventor. As is clear from Applicants' specification at p. 2, lines 1-9, the invention is directed to ameliorating the interference of ghost signals with the sweep signal during the survey. Furthermore, neither these considerations has any relevance to the problem confronting the inventor in Bouyoucus I. Not only has the Office failed to establish any relevance of these factors to the problems addressed by either Applicants or Bouyoucus, the Office has not even alleged any relevance. These ubiquity and "environmental favoritism" considerations are necessarily irrelevant to the problem facing the inventor and have clearly been seized upon in hindsight.

The Office cites *Ex parte Obiaya*, 227 U.S.P.Q. (BNA) 58, 60 (Bd. Pat. App. & Int. 1985), in refutation of this principle. More particularly, the Office cites this decision for the proposition that “...the fact that applicant [sic] has recognized another advantage which would flow naturally from following the suggestion of the prior art cannot be the basis for patentability when the differences would otherwise be obvious.” The Office misapplies this decision. In *Obiaya*, the Board was addressing the Applicant’s position that he had recognized an unexpected result that rendered the invention patentable over an otherwise properly combined set of references. *Id.* Applicants’ argument is different, as the current situation is different. Applicants are not arguing for patentability over a properly combined set of references. Applicants are arguing that the references are not properly combined.

The second error is that the suggestion for combining the references must be based upon a suggestion *in the prior art*. The Office relies on the knowledge of those skilled in the art, but such knowledge is only applicable if it constitutes prior art. Neither Barr nor Sallas—nor any knowledge in the art—sets forth any *relevant* consideration that would suggest the subject combinations to one of ordinary skill in the art confronted with the problem of ghost signal interference. Applicants’ review has found none. The Office has not cited one, either. Any suggestion for the combination therefore must have come from Applicants’ disclosure.

The third error is that the Office has failed to demonstrate a “reasonable expectation of success.” Even if the other errors are set aside, the Office must establish that the cited art supports some reasonable expectation of success. To measure success, one must necessarily consider the problem being addressed. The Office has failed to identify any teaching in the art that would support any reasonable expectation of successfully mitigating the effects of notch frequencies by substituting common, environmentally favored marine vibrators for the impulse-type sources. Similarly, the Office has failed to identify any teaching *in the art* that would yield a reasonable expectation of success that employing sweep sources in the teachings of Bouyoucus I would mitigate ghost signal interference *or* shape the impulse source signal. As to the latter, substituting a sweep source would actually moot the whole issue, as was established above.

Thus, the Office has not properly combined Bouyoucus I and Barr or Sallas. The Office’s justification for combining the references rests on considerations wholly irrelevant to the problem Applicants’ were addressing or even the problem addressed in Bouyoucus I. The Office has therefore failed cite any valid reason for combining the references, failed identify any

suggestion for the combination *in the prior art*, and failed to demonstrate a “reasonable expectation of success” arising from the combination. Accordingly, the references have not been shown to be properly combinable. *In re Vaeck*, 20 USPQ2d 1438 (Fed. Cir. 1991). And, it is the Office’s burden to establish this proposition. *In re Oetiker*, 24 U.S.P.Q.2d (BNA) 1443, 1446 (Fed. Cir. 1992); *In re Fine*, 5 U.S.P.Q.2d (BNA) 1596, 1598 (Fed. Cir. 1988). Accordingly, Applicants’ respectfully submit that the Office has failed to prove *prima facie* that the claimed invention is obvious.

3. THE IMPROPER COMBINATION MANIFESTS HINDSIGHT

These rejections manifestly arise from the exercise of hindsight. The exercise of hindsight and the lack of a proper suggestion to combine are closely intertwined:

Our case law makes clear that the best defense against the subtle but powerful attraction of a hindsight-based obviousness analysis is rigorous application of the requirement for a showing of the teaching or motivation to combine prior art references. *Combining prior art references without evidence of such a suggestion, teaching, or motivation simply takes the inventor's disclosure as a blueprint for piecing together the prior art to defeat patentability--the essence of hindsight.*

In re Dembiczak, 50 U.S.P.Q.2d (BNA) 1614, 1617 (Fed. Cir. 1999) (citations omitted, emphasis added). “As in all determinations under 35 U.S.C. § 103, the decision-maker must bring judgment to bear. It is impermissible, however, simply to engage in a hindsight reconstruction of the claimed invention, using the applicant’s structure as a template and selecting elements from references to fill the gaps.” *In re Gorman*, 933 F2d 982, 18 USPQ2d 1885 (Fed. Cir. 1991).

The impropriety is apparent when one considers each of the references as a whole, as is required by law and policy. *Bouyoucus I* neither teaches nor suggests that the techniques it discloses are applicable to anything other than impulse-type sources. Furthermore, although Barr and Sallas do teach the use of sweep sources, they teach nothing about mitigating the effects of notch frequencies, *i.e.*:

- Barr teaches a technique compensating for imperfect geophone coupling with an ocean bottom cable, *see, e.g.*, col. 1, lines 8-12; and
- Sallas teaches a method for suppressing pressure waves propagating in undesired directions, *see, e.g.*, col. 1, lines 7-9.

Thus, these rejections are improper because it would not have been obvious to combine the references "...unless one had in mind the purpose taught by appellant." *In re Stencel*, 828 F.2d 751, 754, 4 U.S.P.Q.2d (BNA) 1071, 1073 (Fed. Cir. 1987) (reversing Board holding of obviousness), quoting *In re Bulloch*, 604 F.2d 1362, 1365, 203 U.S.P.Q. 171, 174 (C.C.P.A. 1979) (additional citations omitted).

4. THE REJECTION OVER BOUYOUCUS I IN LIGHT OF BARR AND SALLAS SHOULD BE OVERTURNED

The rejections of claims 1-8 as obvious under 35 U.S.C. § 103 (a) by International Patent Application WO 9706452 ("Bouyoucous I") in view of U.S. Letters Patent 5,724,306 ("Barr") and U.S. Letters Patent 4,918,668 ("Sallas") should therefore be overturned. When the cited art is considered for all that it teaches, and in the context of the knowledge of those skilled in the art, it is clear these rejections arise from the exercise of hindsight. The Office picked and chose references from among the art using Applicants' claims and disclosure as a guide, or template. The result of that hindsight is that the Office cannot properly justify the combination of the references upon which it relies in making the rejection. Accordingly, the Office has failed to establish *prima facie* that the claimed invention was obvious at the time it was made. Applicants therefore pray that the rejections be overturned.

B. CLAIMS 1-8 ARE ALLOWABLE OVER BARBER *ET AL.* IN VIEW OF BARR AND SALLAS

The "final" Office Action rejected claims 1-8 as obvious under 35 U.S.C. § 103 (a) by United States Letters Patent 5,469,404 ("Barber *et al.*") in view of U.S. Letters Patent 5,724,306 ("Barr") and U.S. Letters Patent 4,918,668 ("Sallas"). Barber *et al.* teaches a technique for shaping the seismic signal generated from an array of airguns—just as does International Patent Application WO 9706452 ("Bouyoucous I"). (Abstract, col. 1; lines 13-17; col. 3, lines 46-58) Accordingly, these rejections suffer from the same defects as do those predicated on Bouyoucous I, discussed above.

Applicants therefore adopt herein those arguments set forth above in response to the rejections predicated on Bouyoucous I as the primary reference as if set forth here *verbatim*. More particularly, these rejections are fatally defective in that the references are improperly combined in hindsight based on Applicants' disclosure. Accordingly, the Office has failed to

establish *prima facie* that the claimed invention was obvious at the time it was made. Applicants therefore pray that the rejections be overturned.

**C. CLAIMS 1-8 ARE ALLOWABLE OVER YANG
IN VIEW OF BARR AND SALLAS**

The “final” Office Action rejected claims 1-8 as obvious under 35 U.S.C. § 103 (a) by United States Letters Patent 5,535,176 (“Yang”) in view of U.S. Letters Patent 5,724,306 (“Barr”) and U.S. Letters Patent 4,918,668 (“Sallas”). The Office alleges that Yang, like International Patent Application WO 9706452 (“Bouyoucous I”), teaches a technique employing impulse sources. Applicants therefore adopt herein those arguments set forth above in response to the rejections predicated on Bouyoucous I as the primary reference as if set forth here *verbatim*. More particularly, these rejections are fatally defective in that the references are improperly combined in hindsight based on Applicants’ disclosure.

However, Yang is also not within the scope and content of the prior art. A reference can be asserted against the claimed invention under §103 only if (1) it is within Applicant's field of endeavor, or (2) is reasonably pertinent to the problem facing Applicant even though not within Applicant's field of endeavor. *In re Clay*, 23 U.S.P.Q.2d (BNA) 1058, 1060 (Fed. Cir. 1992). Yang is directed to “sensing an object under water,” col. 1, lines 6-7, which is not seismic surveying. Yang also is not reasonably pertinent to seismic surveying because one of its goals is to eliminate “reverberations” from the sea floor. (col. 1, lines 16-21, 60-64) Eliminating, or even reducing, “reverberations” from the sea floor would, of course, destroy a seismic survey. Accordingly, Yang is not within the scope and content of the prior art.

Nevertheless, even if it were applicable prior art, it teaches away from the present invention since it teaches eliminating or reducing reflections from the sea floor is desirable. (col. 1, lines 16-21, 60-64) It is by now well established that teaching away by the prior art constitutes *prima facie* evidence that the claimed invention is not obvious. *See, inter alia, In re Fine*, 5 U.S.P.Q.2d (BNA) 1596, 1599 (Fed. Cir. 1988); *In re Nielson*, 2 U.S.P.Q.2d (BNA) 1525, 1528 (Fed. Cir. 1987); *In re Hedges*, 228 U.S.P.Q. (BNA) 685, 687 (Fed. Cir. 1986).

The rejections of claims 1-8 as obvious under 35 U.S.C. § 103 (a) by United States Letters Patent 5,535,176 (“Yang”) in view of U.S. Letters Patent 5,724,306 (“Barr”) and U.S. Letters Patent 4,918,668 (“Sallas”) should therefore be overturned. When the cited art is

considered for all that it teaches, and in the context of the knowledge of those skilled in the art, it is clear these rejections arise from the exercise of hindsight. Furthermore, the primary reference Yang is not within the scope and content of the prior art or, if it is, it teaches away from the present invention. Applicants therefore pray that the rejections be overturned.

D. CLAIMS 1 AND 6-8 ARE ALLOWABLE OVER RAY IN COMBINATION WITH BARR AND SALLAS

The “final” Office Action rejected claims 1 and 6-8 as obvious under 35 U.S.C. § 103 (a) by United States Letters Patent 4,493,061 (“Ray”) in combination with U.S. Letters Patent 5,724,306 (“Barr”) and U.S. Letters Patent 4,918,668 (“Sallas”). The Office alleges that Ray, like International Patent Application WO 9706452 (“Bouyoucous I”), teaches a technique employing impulse sources. Applicants therefore adopt herein those arguments set forth above in response to the rejections predicated on Bouyoucous I as the primary reference as if set forth here *verbatim*. More particularly, these rejections are fatally defective in that the references are improperly combined in hindsight based on Applicants’ disclosure. Note, however, that Ray—unlike Bouyoucous I—admittedly does teach mitigation of notch frequencies arising from ghost reflections and does not address pulse shaping. Again, though, approaches mitigating the effects of notch frequencies in impulse sources are generally inapplicable to sweep sources. (p. 4 of the specification at filed, lines 18-25). Accordingly, the Office has failed to establish *prima facie* that the claimed invention was obvious at the time it was made. Applicants therefore pray that the rejections be overturned.

E. CLAIMS 1 AND 6-8 ARE ALLOWABLE OVER MANIN IN COMBINATION WITH BARR AND SALLAS

The “final” Office Action rejected claims 1 and 6-8 as obvious under 35 U.S.C. § 103 (a) by United States Letters Patent 4,136,754 (“Manin”) in combination with U.S. Letters Patent 5,724,306 (“Barr”) and U.S. Letters Patent 4,918,668 (“Sallas”). The Office alleges that Manin, like International Patent Application WO 9706452 (“Bouyoucous I”), teaches a technique employing impulse sources. Applicants therefore adopt herein those arguments set forth above in response to the rejections predicated on Bouyoucous I as the primary reference as if set forth here *verbatim*. More particularly, these rejections are fatally defective in that the references are improperly combined in hindsight based on Applicants’ disclosure. Accordingly, the Office has

failed to establish *prima facie* that the claimed invention was obvious at the time it was made. Applicants therefore pray that the rejections be overturned.

F. CLAIMS 1 AND 6 ARE ALLOWABLE OVER HUIZER IN LIGHT OF BARR AND SALLAS

The “final” Office Action rejected claims 1 and 6 as obvious under 35 U.S.C. § 103 (a) by United States Letters Patent 4,727,956 (“Huizer”) in light of U.S. Letters Patent 5,724,306 (“Barr”) and U.S. Letters Patent 4,918,668 (“Sallas”). Like International Patent Application WO 9706452 (“Bouyoucous I”), Huizer teaches a technique employing impulse sources and a technique for shaping the pulses they produce. Applicants therefore adopt herein those arguments set forth above in response to the rejections predicated on Bouyoucous I as the primary reference as if set forth here *verbatim*. More particularly, these rejections are fatally defective in that the references are improperly combined in hindsight based on Applicants’ disclosure. Accordingly, the Office has failed to establish *prima facie* that the claimed invention was obvious at the time it was made. Applicants therefore pray that the rejections be overturned.

G. CLAIMS 1-10 ARE ALLOWABLE OVER LUGG IN COMBINATION WITH BARR AND SALLAS

The “final” Office Action rejected claims 1-10 as obvious under 35 U.S.C. § 103 (a) by UK patent application GB 2,148,503 (“Lugg”) with U.S. Letters Patent 5,724,306 (“Barr”) and U.S. Letters Patent 4,918,668 (“Sallas”). Like International Patent Application WO 9706452 (“Bouyoucous I”), Lugg teaches a technique employing impulse sources. Applicants therefore adopt herein those arguments set forth above in response to the rejections predicated on Bouyoucous I as the primary reference as if set forth here *verbatim*. More particularly, these rejections are fatally defective in that the references are improperly combined in hindsight based on Applicants’ disclosure. Note, however, that Lugg—unlike Bouyoucous I—admittedly does teach mitigation of ghost reflection interference and does not address pulse shaping. Again, though, approaches mitigating the effects of notch frequencies in impulse sources are generally inapplicable to sweep sources. (p. 4 of the specification at filed, lines 18-25). Accordingly, the Office has failed to establish *prima facie* that the claimed invention was obvious at the time it was made. Applicants therefore pray that the rejections be overturned.

**H. CLAIMS 1-8, 19-29 ARE ALLOWABLE OVER HAUGLAND *ET AL.*
IN LIGHT OF BARR AND SALLAS**

The “final” Office Action rejected claims 1-8, 19-29 as obvious under 35 U.S.C. § 103 (a) by United States Letters Patent 4,721,180 (“Haugland *et al.*”) in light of U.S. Letters Patent 5,724,306 (“Barr”) and U.S. Letters Patent 4,918,668 (“Sallas”). Like International Patent Application WO 9706452 (“Bouyoucous I”), Haugland *et al.* teaches a technique employing impulse sources. Applicants therefore adopt herein those arguments set forth above in response to the rejections predicated on Bouyoucous I as the primary reference as if set forth here *verbatim*. More particularly, these rejections are fatally defective in that the references are improperly combined in hindsight based on Applicants’ disclosure. Note, however, that Haugland *et al.*—unlike Bouyoucous I—admittedly does teach mitigation of ghost reflection interference and does not address pulse shaping. Again, though, approaches mitigating the effects of notch frequencies in impulse sources are generally inapplicable to sweep sources. (p. 4 of the specification at filed, lines 18-25).

Additionally, the Office stated in the “final” Office Action:

...applicants [sic] argue that none of the references disclose “varying the depth” of the marine vibrator as claimed in claimed 19 and 25. This argument is not found convincing since Haugland *et al* do suggest such on col. 5, lines 54+.

Detailed Action, p. 6, ¶ 10. This refers to Applicants’ argument that the prior art fails to teach “varying the depth of a marine vibrator while the marine vibrator is emitting seismic energy.” This limitation is found in both claim 19 and in claim 25. Col. 5, lines 54+ of Haugland *et al.* reads:

The sizes of the air guns used and the spacing between the air guns will depend on the signal that it is desired to transmit into the earth. Methods of selecting the air gun sizes and the distances between the air guns are known in the art and will not be described herein. It is also well known that the depth at which the sources are positioned will influence, to a certain extent, the frequency content of the emitted seismic signal. As the position of the sources becomes deeper, the more energy will be emitted at lower frequencies. The vertical distances between the air guns may also vary, so long as the timing with which the air guns are fired with respect to each other is varied accordingly. In addition, the acoustic wave field will behave as if it originated from a true point (non-directive) source, within a desired bandwidth, if the length of the array is appropriately selected.

Although the invention has been described as a system for deploying a first tier of source elements at a first depth and a second tier of source elements at a second depth, the invention may be implemented with source elements deployed at three or more different depths. The firing times for the source elements will be altered accordingly so that waves propagated downwardly are additive, but waves first propagated toward the water surface and then reflected downward will destructively interfere.

Not only does this passage not mention a marine vibrator, it does not even mention any type of impulse source other than an air gun. Furthermore, there is no mention of varying the depth of an air gun as it fires, a notion that is highly impracticable—if not impossible—to implement in practice. Thus, with respect to claims 19 and 25, the rejections fail for this additional reason.

Accordingly, the Office has failed to establish *prima facie* that the claimed invention was obvious at the time it was made. Applicants therefore pray that the rejections be overturned.

CLAIMS APPENDIX

The claims that are the subject of the present appeal—claims 1-10 and 19-29—are set forth in the attached “Claims Appendix.” Claims 11-18 and 30 are also set forth for the convenience of the Board.

EVIDENCE APPENDIX

There is no separate Evidence Appendix for this appeal.

RELATED PROCEEDINGS APPENDIX

There is no Related Proceedings Appendix for this appeal.

CONCLUSION

Applicants therefore respectfully submit that the claims are allowable over the art of record. It is apparent that the Office, upon reading Applicants’ claims, located a number of references teaching various pieces of the invention and pasted them together in hindsight to reject Applicants’ claims. It is the only reasonable explanation put forth in this prosecution for the Office’s position that a person skilled in the art seeking to mitigate ghost signal interference would look to references teaching how to make a seismic survey more eco-friendly. This is the

epitome of impermissibly using the Applicants' disclosure as a "template", "guide" or "pattern" through the prior art.

The Office admonishes Applicants that "...it must be recognized that any judgment on obviousness is in a sense necessarily a reconstruction based upon hindsight reasoning." Detailed Action, p. 7, ¶ 10. This is true, but it must be tempered:

As in all determinations under 35 U.S.C. section 103, the decision-maker must bring judgment to bear. It is impermissible, however, simply to engage in a hindsight reconstruction of the claimed invention, using the applicant's structure as a template and selecting elements from references to fill the gaps.

In re Gorman, 933 F2d 982, 18 USPQ2d 1885 (Fed. Cir. 1991). *Gorman* describes exactly what the Office did in this case—as is established by the fact that the reason the Office chose for combining the references was completely irrelevant to the problem facing the inventor.

The Office, in continuing its admonishment, goes on to note that, "[b]ut so long as it takes into account only knowledge which was within the level of ordinary skill at the time the claimed invention was made, and does not include knowledge gleaned only from the applicant's [sic] disclosure, such a reconstruction is proper." Detailed Action, p. 7, ¶ 10. However, as mentioned above, the Office's position could only have been formulated with "knowledge gleaned" from Applicants' disclosure. One addressing notch frequency mitigation only finds the "eco-friendly suggestion" in the art if one is looking for it, and one is only looking for it if they have seen Applicants' disclosure. Hence, the Office's whole position is voided.

Because the Office has allowed its hindsight to overwhelm the proper analysis of the prior art, the rejections all suffer several fatal defects in the *prima facie* case. More particularly:

- the reasoning rests on the irrelevant considerations of ubiquity and environmental favoritism of sweep-type sources;
- there is no suggestion for the combination *in the prior art*; and
- the Office has failed to demonstrate a "reasonable expectation of success" arising from the combination.

Furthermore, with respect to claims 19 and 25, the Office has failed to establish that the cited references, even taken collectively, teach or suggest all the limitations of the claims.

Accordingly, Applicants request that the rejections be overturned and the claims allowed to issue.

Please date stamp and return the enclosed postcard to evidence receipt of this document.

Respectfully submitted,

Date: September 19, 2005

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APPENDIX
(Claims in Issue)

1. (Previously Presented) A method of seismic surveying using one or more marine vibrators, the method comprising emitting seismic energy at two or more different depths during a sweep.
2. (Original) A method as claimed in claim 1 and comprising emitting seismic energy from an array of marine vibrators, the array of marine vibrators comprising at least a first vibrator at a first depth and a second vibrator at a second depth greater than the first depth.
3. (Original) A method as claimed in claim 2 wherein the first vibrator of the array is displaced with respect to the second vibrator in the direction of emission of seismic energy.
4. (Original) A method as claimed in claim 2 or 3 and further comprising starting emission of seismic energy from the second vibrator a pre-determined time after starting emission of seismic energy from the first vibrator.
5. (Original) A method as claimed in claim 4 wherein the pre-determined time is substantially equal to the time taken for seismic energy emitted from the first vibrator to reach the second vibrator.
6. (Original) A seismic surveying arrangement comprising:
a vessel;
a source of seismic energy; and
means for suspending the source of seismic energy from the vessel;
wherein the source of seismic energy is an array of two or more marine vibrators, the array being suspended in use such that a first vibrator is disposed at a first depth and a second vibrator is disposed at a second depth greater than the first depth.
7. (Original) An arrangement as claimed in claim 6 wherein the first vibrator is displaced with respect to the second vibrator in the direction of emission of seismic energy.
8. (Original) An arrangement as claimed in claim 6 or 7 wherein the array includes four to six marine vibrators.

9. (Original) An arrangement as claimed in claim 8 and comprising four vibrators at a depth of substantially seven metres, one vibrator at a depth of substantially twelve metres and one vibrator at a depth of substantially fifteen metres.

10. (Original) An arrangement as claimed in claim 8 and comprising two vibrators at a depth of substantially seven metres, one vibrator at a depth of substantially eight metres, one vibrator at a depth of substantially eleven metres, and two vibrators at a depth of substantially fifteen metres.

11. (Withdrawn) A method of calculating the preferred depths for seismic sources in an array of a plurality of seismic sources, the method comprising the steps of:

- a) assigning a depth to each seismic source in the array;
- b) for each seismic source in the array, obtaining the amplitude spectrum of seismic energy emitted by the seismic source;
- c) summing the results of step (b) to obtain the amplitude spectrum of seismic energy emitted by the array of seismic sources; and
- d) generating a parameter indicative of a property of the amplitude spectrum of seismic energy emitted by the array of seismic sources.

12. (Withdrawn) A method as claimed in claim 11 wherein step (b) comprises summing energy received at a point directly from the seismic source and energy received at the point after reflection from the sea surface.

13. (Withdrawn) A method as claimed in claim 11 or 12 wherein the parameter is indicative of the amplitude of the spectrum of the array in a first frequency band.

14. (Withdrawn) A method as claimed in claim 11 or 12 wherein the parameter is indicative of the variation of the amplitude of the spectrum of the array in a second frequency band.

15. (Withdrawn) A method as claimed in claim 11 or 12 wherein the parameter is the sum of a first parameter indicative of the amplitude of the spectrum of the array in a first frequency band and a second parameter indicative of the variation of the amplitude of the spectrum of the array in a second frequency band.

16. (Withdrawn) A method as claimed in claim 11 or 12 wherein the parameter is a weighted sum of a first parameter indicative of the amplitude of the spectrum of the array in a first frequency band and a second parameter indicative of the variation of the amplitude of the spectrum of the array in a second frequency band.

17. (Withdrawn) A method as claimed in any of claims 11 or 12 and further comprising the steps of:

- e) assigning a new depth to one or more of the seismic sources; and
- f) repeating steps (b), (c) and (d).

18. (Withdrawn) A method as claimed in any of claims 11 or 12 wherein each seismic source is a marine vibrator.

19. (Original) A method of seismic surveying as claimed in claim 1, comprising varying the depth of a marine vibrator while the marine vibrator is emitting seismic energy.

20. (Original) A method as claimed in claim 19 and further comprising the step of varying the frequency of the seismic energy emitted from the marine vibrator.

21. (Original) A method as claimed in claim 20 wherein the frequency of the seismic energy emitted from the marine vibrator is varied such that the ratio of the depth of the marine vibrator to the wavelength of the seismic energy emitted from the marine vibrator is substantially constant.

22. (Original) A method as claimed in claim 21 wherein the ratio of the depth of the marine vibrator to the wavelength of the seismic energy emitted from the marine vibrator is approximately one quarter.

23. (Original) A method as claimed in any of claims 19 to 22 wherein the depth of the marine vibrator is reduced while the marine vibrator is emitting seismic energy.

24. (Original) A method as claimed in claim 23 wherein the initial depth is 50m, the initial frequency is 7.5Hz, the final depth is 5m and the final frequency is 75Hz.

25. (Previously Presented) A seismic surveying arrangement comprising:

a vessel;
a marine vibrator;
means for suspending the marine vibrator from the vessel;
a first control means for causing the marine vibrator to emit seismic energy; and
a second control means for varying the depth of the marine vibrator as it emits the seismic energy.

26. (Original) An arrangement as claimed in claim 25 wherein the second control means is adapted to control the depth of the marine vibrator on the basis of the wavelength of the seismic energy emitted by the marine vibrator.

27. (Original) An arrangement as claimed in claim 26 wherein the second control means is adapted to control the depth of the marine vibrator such that the ratio of the depth of the marine vibrator to the wavelength of the seismic energy emitted from the marine vibrator is substantially constant.

28. (Original) An arrangement as claimed in claim 27 wherein the second control means is adapted to control the depth of the marine vibrator such that the ratio of the depth of the marine vibrator to the wavelength of the seismic energy emitted by the marine vibrator is approximately one quarter.

29. (Original) An arrangement as claimed in any of claims 25 to 28 wherein the first control means is the second control means.

30. (Previously Presented) A method as claimed in claim 1 further comprising determining the preferred depths, the determination including:

- a) assigning a depth to each seismic source in the array;
- b) for each seismic source in the array, obtaining the amplitude spectrum of seismic energy emitted by the seismic source;
- c) summing the results of step (b) to obtain the amplitude spectrum of seismic energy emitted by the array of seismic sources; and
- d) generating a parameter indicative of a property of the amplitude spectrum of seismic energy emitted by the array of seismic sources.